HYPOSPADIAS

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In order to explain the reasoning which leads to the technique described, it is necessary first to state the requirements of a satisfactory operation. With these in mind one can then set out the many unfavourable factors facing the surgeon in his correction of this deformity, and against them place the few but important favourable ones. From this statement of the elements of the problem a solution is then deduced.

Requirements for a Satisfactory Operation

1. *It must be applicable to all degrees of the deformity.* The misplaced opening of the urethra may be anywhere from just in front of the anus ranging forwards through a cleft scrotum to the base of the penis, and thence to just short of the normal position. Without discussing in detail the vast number of procedures described in the literature, it is undeniable that none of them tackle the really difficult types. The operations of Edmunds, Bucknill, Ombredanne and the various free-graft techniques all lose their usefulness as the root of the penis is passed.

2. *It must construct a urethra free from hairs on the inside.* If this obvious requirement is not observed, phosphatic calculi will form upon the hairs with extremely inconvenient results. This places out of consideration the procedure of Bucknill in all cases, and that of Ombredanne in all but the mildest.

3. *The new urethra must be of a size and elasticity approximately normal.* A urethra wide enough to allow free micturition but too narrow to permit the insertion of a cystoscope may not cause trouble to its owner. But it is hardly necessary to labour the point that there may be trouble and it may be very serious. I think there are very few, if any, urethrae constructed by free skin grafts that will pass this test.

4. *It must be capable of completion by the time the child first goes to school,* that is to say about five years of age. The importance of this to the affected boy is immense, for obvious reasons. I do not say that the published procedures are never completed by this time, but it must be a most uncommon event if they are.

5. *It should be capable of consistent performance*

by any reasonably skilful surgeon and not depend upon either great technical accomplishment or great good fortune.

Unfavourable Factors in the Operation

1. *The passage of urine through the operation area.* If this is allowed to go on it has both a mechanical and a physiological action in hindering healing. A flood of urine let loose at high pressure into the newly-joined tissues is very apt to find a way out other than that intended by the surgeon, and this new opening will become skin-lined and therefore permanent with amazing rapidity. The physiological action of urine is not so important, but in its presence true primary union does not occur.

2. *The presence of erectile tissue.* In my experience erections are not one of the major hindrances to the success of the operation, but if they could throw a sudden increase of tension upon a line of sutures this would be disastrous.

3. *The tendency of the subcutaneous tissues of the region to excessive oedema upon trauma.* This is one of the really great difficulties, as oedema both puts tension upon sutures and impedes circulation, with consequent defective healing.

4. *The extreme thinness and fragility of the penile skin.* A degree of tension upon sutures that would be perfectly safe on the face or the abdomen will cut through the skin of the penis with rapidity and completeness.

5. *The difficulty of getting sufficient skin at certain points.* At the distal end of the penis there is in the prepuce a superfluity of skin; at its base there is none at all to spare for surgical manoeuvres. To get the epidermal resources equally distributed is a problem to which many answers have been attempted.

Favourable Factors in the Operation

1. *The character of the penile skin.* This is quite different from that of any other skin in the body, and in many ways resembles the mucous membrane which is the normal lining of the urethra. The curious and easy change of the surface of the glans and the inside of the prepuce from a sheltered and mucous-secreting state to an exposed and dry one is extremely interesting and

suggestive. For the purpose of the operation the penile skin, including the large reservoir of surface in the prepuce, has many important properties. It is hairless ; it is extremely mobile ; it is extremely extensible and (most important of all) it never forms keloid.

There are many puzzling points about the behaviour of this surface. No one has ever seen contraction or keloid along the line of a circumcision scar, provided that scar remains in its proper place. But if, during healing, the line of incision is allowed to slip forward over the tip of the glans, it contracts into a tight ring that will hardly allow the passage of urine. Similarly, the complete absence of thickening or contraction in the subcutaneous tissues after the procedure described is in curious contrast to the persistent accumulations of tough fibrous scar tissue after a gonococcal ulceration or a traumatic division of the urethra. However, there is no doubt about the fact that if a channel is constructed lined with penile skin it will remain indefinitely, with no tendency to contract. This is well shown in the persistent post-operative fistula which is the well-known bugbear of the surgeon in this condition. This has all the qualities of the ideal artificial urethra ; it has a hairless elastic lining and no tendency to contract.

2. *The presence of a reservoir of suitable surface for a new urethra in the prepuce.* In this curious structure there is, as a mere matter of geometry, enough area of no functional use to supply a new under surface to the penis when that is needed, and in addition to form a buried tube of the necessary length and diameter. I have found that by taking advantage of the properties of this skin in the way of mobility, extensibility and power of epithelialization it is possible, by very simple measures, to effect the necessary changes of position.

First Stages of the Operation

In the severer degrees of the deformity there is a curious element, something more than the simple failure of fusion, that is seen in such apparently similar conditions as a hare-lip or cleft palate. This is a failure of development of the parts concerned, the under surface of the penis and the corpus spongiosum, so that they are only represented by a short fibrous band that ties down the penis into a permanent chordee. In addition there may be two other elements needing treatment, a narrowing of the urinary meatus and a failure of development of its floor, which may consist of two extremely thin fused sheets of skin and mucosa. The urethral meatus must be enlarged to a proper size and if the floor is unduly thin it must be slit up and skin sewn to mucosa by

minute catgut sutures so as to preserve the size of the opening.

The chordee is treated very simply by incising transversely across the penis just below the glans and continuing the cut out into the prepuce on either side. Then the penis is pulled out straight with one hand while, with a blunt scissors in the other, everything that prevents straightening of the penis is divided and freed, so that it can slip down towards the base. When the penis will straighten easily and completely, the transverse cut is sewn into a longitudinal line by fine catgut sutures. This will produce a tightening of the skin round the proximal part of the penis, which is relieved by a simple incision down the dorsum. The mobility of the penile skin in this region often shows by the way in which the turning of a transverse incision into a longitudinal one on the ventral surface is countered automatically by the longitudinal relieving incision on the dorsum stretching out transversely. This incision is left unsutured to heal as it will.

When the penis is straightened and the ventral surface covered, it is wrapped in ribbon gauze soaked with paraffin and flavine. This dressing is left on for a week and then removed after softening in a hot bath. If the freeing has been properly done there is no tendency for the chordee to recur, and the penis will usually grow in a surprising way once normal erections are possible.

The best time for this preliminary operation is about 18 months of age, when the child and the parts are large enough to make the operation fairly safe and easy, but on the other hand there are still some years left for the penis to grow before the new urethra is constructed.

Second Stage of the Operation

1. *Diversion of the urine.* This is essential for the reasons given. It is sometimes objected to upon the grounds that it increases the severity of the operation. It certainly adds an extra procedure, but apart from the great increase in the probability of primary healing which it gives, there is an equally great diminution in the pain suffered by the patient. Anyone who has watched the first passage of urine through a newly-constructed urethra must be struck with the way in which the anticipation of pain makes the child restrain the act, until forced to yield by the distension of the bladder, and with the agony caused by the letting loose of a flood of high pressure fluid into the raw tissues. The granulation tissue which forms after a few days is far less sensitive. Suprapubic drainage, which I have used in many cases, is far less satisfactory than perineal. Its main fault is that it does not fulfil the purpose of keeping urine out of the urethra. The reason for this is that the child

FIG. 1.—Technique of perineal drainage. The Malecot catheter has been inserted into the bladder on a sound, which is now shown half withdrawn and with its curve reversed, so that the point makes the catheter project in the perineum. A cut is being made down upon this point with a diathermy needle. The catheter will be thrust out through this cut as soon as a piece of it is exposed.

FIG. 2.—Outlining the ventral incisions and raising the lateral flaps of penile skin. The small figure on the right shows the outlines of the strip of skin that will be buried to form the new urethra. The main drawing shows the lateral flaps raised and dissected free, and the puncturing of the scrotum on either side to allow free egress of blood and serum.

FIG. 3.—Showing the dorsal relaxation incision on the penis. On the left is the line of the incision, and on the right the appearance of the penis after it has been made and spread widely open.

FIG. 4.—Showing the drawing of the lateral skin flaps over the isolated strip of skin which is buried to form the new urethra. The 'double-stop' sutures are shown being inserted to keep all tension off the tiny catgut sutures which join the skin edges. The glass bead is threaded on the nylon suture with the aluminium cylinder behind it. The aluminium cylinder of the upper nylon suture has not yet been crushed.

FIG. 5.—The completed suturing. The new ventral surface of the penis is drawn up on to the glans, so that its raw under surface is in contact with the raw patches on either side of the new meatus, and held there by several catgut mattress sutures. The sutures holding the draining catheter in position are shown.

tries to micturate at intervals, the sphincter of the bladder relaxes to allow the proximal urethra to fill and then its contents are driven forward by the ejaculator urinae. Though this small amount of urine is not so deadly to healing as the full contents of the bladder, it can be very inconvenient.

I have found a Malecot catheter very satisfactory; some self-retaining device is necessary as otherwise the catheter will be inevitably extruded by bladder contractions. It is passed on a sound into the bladder and then the sound is withdrawn partially and reversed so that its point is made to protrude in the perineum. A cut about an inch long is then made down upon this point by a diathermy knife, and as soon as a tiny piece of rubber shows at the bottom of the cut the catheter is thrust out through the soft floor of the urethra (Fig. 1). In this way a very small hole is made which closes within a day or two after withdrawal of the tube. I think that persistent sinuses in this region, which are occasionally reported, must be due to a far too large and wide opening of the urethra.

A linen suture is then inserted to close the skin and this is then tied tightly round the catheter. Another stitch of the same material is inserted loosely into the skin an inch away from the incision and this again is tied round the catheter. These stitches are to guard against the catheter being dragged out by the child, the danger of this being particularly great when he is half asleep. It is curious how little the catheter is resented, which may be partly because the child cannot see it and does not realize it is there. From the catheter a narrow plastic tube leads into a bottle under the bed, thus providing a negative pressure which keeps the bladder empty.

2. *Formation of the urethra.* Taking advantage of the peculiar local reactions which have been set out, this passage is formed deliberately as a fistula. A strip of skin is buried, with no attempt to sew its edges together, leaving the spread of epithelium from it and the closing of the healing tissues round it to form it inevitably into a tube. I find that surgeons who have heard of this device but have not the time to come and see the cases upon which it has been used nearly always object that it must result in a stricture. There are three answers to this. The first and most important is that it doesn't. The second is that accidental fistulae have no tendency to obliteration by stricture formation, and deliberately produced ones behave in the same way. The third is that urethras produced by Edmunds, perhaps the first man to gain a large number of successes in this condition, were perfectly satisfactory. Yet it is obvious that his technique of raising and suturing

the edges of the buried strip to form a tube must surround far more of its circumference with scar tissue than leaving it as a flat ribbon. In addition, the omission to suture the edges means that a certain amount of new surface is formed by the spread of epithelium from them before they unite, with a consequent widening of the bore. It is interesting to compare this method with Hamilton Russell's operation for the excision of gonococcal strictures, in which he merely sewed a flat strap of urethral mucosa together where the stricture had been and left this to form a tube spontaneously.

Fig. 2 shows the lines of incision to outline the urethral strip.

I have found much the best instrument for this purpose to be very sharp-pointed small scissors, one blade of which is thrust under the skin. These scissors are also used for the small, but far from easy, detail of stripping the very adherent skin from the glans on either side of the site of the new meatus.

The skin flaps are raised up widely on either side by divulsion with blunt scissors, so that they can fall together quite loosely with about an inch to spare; there must not be the slightest suspicion of tension on the joining flaps. A considerable amount of haemorrhage occurs during this process, but I think it is inadvisable to ligature any but large and obvious bleeding points. Attempts to gain a perfectly dry field waste time and are apt to fill the wound with catgut and damaged tissue. I have never known the bleeding to cause anxiety.

3. *The relaxation incision.* To get the complete relaxation that has been mentioned it is necessary to take full advantage of the mobility and extensibility of the penile skin by means of a longitudinal dorsal slit, similar to that made in the first stage. This is spread widely open (Fig. 3) and allowed to epithelialize spontaneously, a process which, as has been pointed out, occurs rapidly and easily in the penis in a way that suggests the healing qualities of mucosa rather than skin.

In addition to doing away with tension, this incision has another function in preventing the excessive oedema, which is one of the difficulties of the region, by allowing free outflow of serum. To guard against oedema in the scrotum small incisions should be made with the sharp-pointed scissors, running from the inner raw surfaces out through the skin (Fig. 2). No drains are used in these small holes and they heal rapidly and automatically.

4. *Tension sutures for the lateral flaps.* All that is necessary for the success of the operation is to get a junction of the skin edges along the ventral line of suture. This will occur rapidly and soundly inside a week, provided that all tension is kept off

the edges, that no urine is allowed to burst them apart and that they are adjusted with extreme accuracy.

After many experiments I have worked out a device which I have found very satisfactory for this and other operations in which tension has to be kept off joining skin edges. I call it the 'double stop' suture. It is a variant of the ancient trick of crushing a split shot or lead bead on the suture, which has the obvious advantage of not grasping any tissues and so interfering with the blood supply to the healing edges as do ordinary deep sutures. I think the reason why split shot of this kind have fallen out of use is that lead is an unsuitable metal, because of its extreme softness, which allows the suture to pull through when quite a small force is applied. In addition the crushing of the shot deforms it.

The double stop suture consists of one bead or button which goes against the skin, and an aluminium cylindrical bead which is threaded on the suture to the outer side of it and locks the suture when crushed upon it. To crush it a very efficient instrument can be made by cutting down the jaws of an old pair of artery forceps to about $\frac{1}{4}$ in. and removing the catches (Fig. 4). These stop sutures are placed about $\frac{1}{2}$ in. away from the edges of the skin flaps, and adjusted so that when locked there is an $\frac{1}{8}$ in. of slack in them. If they are drawn tight they may cause sloughing where their pressure comes.

To remove them one cuts between the two beads, which has the advantage that the skin is not touched and consequently very little objection is

made by the child when they are taken out. Even lightly applied stops may sink into the tissues in a way that makes it difficult to cut between them and the skin, particularly in a very sensitive region and with a young patient.

5. *Joining the skin edges.* This is done by the smallest possible catgut sutures applied with the utmost care, to avoid inversion or maladjustment. When the whole ventral surface of the flaps has been joined, it is then lifted upwards and sewn to the tip of the glans so that the raw under surfaces of the penile skin are in contact with the raw surfaces produced on either side of the new meatus.

6. *After treatment.* If there is any oozing after operation, this may be controlled by a pad and firm pressure for a few hours, but after this the wounds are left open to the air with no dressing but sulphonamide and penicillin powder blown upon them. The stop sutures are removed after seven days and the urethral catheter after a week; the child is then allowed to get up. It is perhaps necessary to give a warning to those unfamiliar with operations of the kind that the oedema and the large bare area on the dorsum of the penis make the immediate post-operative appearance in many cases rather alarming. They may be consoled with the assurance that the healing processes will restore the normal outline in the most astonishing way in the course of a few weeks. Along the line of the new urethra there is for about a year a steadily diminishing thickening in the subcutaneous tissues; this finally disappears and the tissues become supple and elastic.

* Footnote to Editorial (p. 356).

Mr. Morson points out that this example of a patient making use of his relationship to a surgeon for commercial purposes is not unique. Many years ago when a patient of Mr. Morson's arrived at a nursing home in order to undergo a serious operation, he brought with him two bags, one containing his clothes, the other rolls of toilet paper. He asked the Sister-in-charge to distribute these latter among the inmates of the home. It subsequently transpired he was the proprietor of a well-known brand of toilet paper, of which these rolls were samples.